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Analysis and Control of DC-DC Converter using Average Power Balance Control in Renewable Power Sources

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ABSTRACT

In any type of power conversion basic requirement is converter. Converter is the heart of power electronics. All type of power converter requires some special technique to control the converter. In this project some of this type converter and its control strategy is designed and developed.In current scenario use of DC to DC converter is increased due to numerous advantages and lots of applications. Efficiency and performance of the converter increased with latest control strategy. In this project one of the control methods is design for dc to dc converter. Average power balance control (APBC) scheme is designed and analyzed for a boost converter. The proposed scheme consists of two control loops, the fast inner current loop uses hysteresis current control (HCC) and outer voltage loop uses the average power balance algorithm (APBA), which contains average power balance equation (APBE) and PI controller.The existence condition of HCC is derived such that the stable tracking performance can be ensured under occurrence of system uncertainties. The proposed APBC scheme is modeled and simulated using MATLAB / SIMULINK. The effectiveness of APBC in terms of voltage tracking, transient response and robustness to uncertainties in parameters are verified by simulation result.

Keywords*-Boost Converter, Bi-Directional Converter, PV, Wind Mill, Micro Grid*

I. INTRODUCTION

In this world among the various types of renewable energy sources but wind power has now a day emerged as one of the most promising of the renewable energy technologies. Nowadays, we think there is appetite to extension the size and capacity of wind energy conversion system. Solar and Wind power is most of the renewable energy sources, is naturally fluctuation. Then possesses different role in the power system compared to the conventional power plants, such as thermal power plants. The integration of wind power into the power system increases and Wind energy conversion system continue to complement the Conventional power plant the effect of wind power on the power system becomes mentionable and must be taken into consideration. The objective of this project is to minimize the generating cost. Generating cost can be reducing with optimizing the generating power. Generate the renewable energy and it energy store the battery .Nov this energy necessary to use in power system or grid. Boost converter use to control average power balance control in renewable power sources. The boost converter is a bilinear system and it is also a non minimum phase system with respect to the output to be controlled. Renewable energy has been increased significantly during the past decade. System voltage is low that increase the boost converter.

II. PV Cell

Photovoltaic are best known as a method for generating electric power by using solar cells to convert energy from the sun into a flow of electrons. The photovoltaic effect refers to photons of light exciting electrons into a higher state of energy, allowing them to act as charge carriers for an electric current. Photovoltaic cell made from a mono crystalline silicon wafer with its contact grid made from bus bars and fingers. Solar cell or photovoltaic cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect.

Figure 1 PV Cell

Photoelectric cell defined as a device whose electrical characteristics, such as current, voltage, or resistance, very when exposed to light. Solar cell building block of photovoltaic modules, otherwise known solar panels. They are used as a photo detector, detecting light or other electromagnetic radiation near the visible range or measuring light intensity .The operation of photovoltaic cell requires three basic attributes:

1- The absorption of light, generating either electron-hole pairs or exactions.
2- The separation of charge carries of opposite types.
3- The separate extraction of those carriers to an external circuit.

III. Wind Mill

Wind mill is a machine that converts the energy of wind into rotational energy by means of vanes called sails or blades. It uses the wind to make energy. The majority of modern windmill take the form of wind turbines used to generate electricity, or wind pumps used to pump water either for land drainage or to extract ground water. Usually, a wind mill is a large building; common types of windmills are post mills, smock mills and tower mills. Usually, a windmill is a large building. Common types of windmills are post mills, smock mills and tower mills. The energy made by windmills can be used in many ways. These include grinding grain or spices, pumping water and sawing wood. Modern wind power machines are used to create electricity. These are called wind turbines. The reason for the name "windmill" is that the devices originally were developed for milling grain for food production; the name stuck when in the course of history, windmill machinery was adapted to supply power for many industrial and agricultural needs other than milling.

III. BOOST CONVERTER

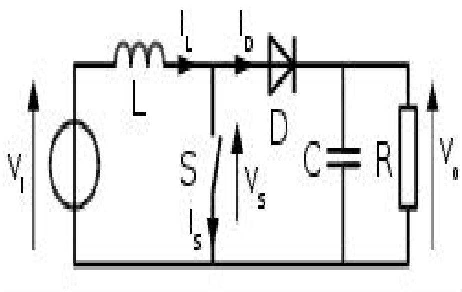

Figure 2 Boost Converter

Power for the boost converter can come from any suitable DC sources, such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC to DC conversion. A boost converter is a DC to DC converter with an output voltage greater than the source voltage. A boost converter is sometimes called a step-up converter since it "steps up" the source voltage. Since power must be conserved, the output current is lower than the source current. The switch is typically a *MOSFET, IGBT, or BJT*.

It is used as the first stage of clean energy power system to generate a higher regulated dc voltage for the later inverter utilization. The energy transfer mode and output voltage ripple of a boost converter are analyzed within the given range of the input voltage and load. The relationship between the maximum output voltage ripple, maximum input current ripple and element parameters ripple of the converter are derived. The boost converter is a bilinear system and it is also a no minimum phase system with respect to the output to control.SMPS containing at least two semiconductors and at least one energy storage element, capacitor, inductor or the two in combination. Filter made of capacitor are normally added to the output of the converter to reduce output voltage ripple .Power for the boost converter comes from any suitable dc sources such as batteries, solar \panels, rectifiers and dc generator. The process that changes one dc voltage to the different dc voltage is called dc to dc conversion .In the on state the switch S is closed, resulting in an increase in the inductor current. Polarity of left side of the inductor is positive. In the off-state the switch is open and the only path offered to inductor current is through the fly back diode D, the capacitor C and load R. this result in transferring the energy accumulated during the on-state in to the capacitor.

IV. BI-DIRECTIONAL CONVERTER

This converter work in two modes such as one is boost mode and another is buck mode. Boost mode converter work that time output voltage higher then input voltage. It output current lower than the input current. Buck mode converter work that time output voltage lower then input voltage. It output current higher than the input current.

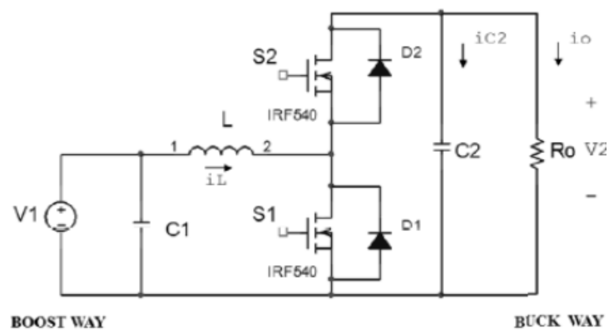

Figure 3 Bi-Directional Converter

V. Experiment and Results

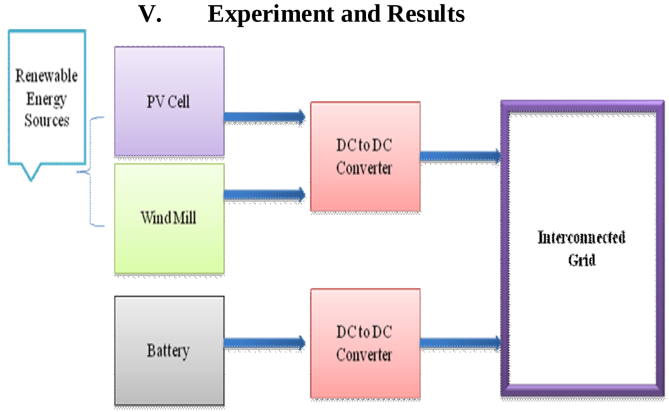

Figure 4 Block Diagram of APBC

In this section one of the applications of APBC in solar power generation is described. The DC micro grid consisting of PV panel, wind mill and battery arrangement is shown in Fig. 4. Here, the boost converter is used to extract the power from PV panel and Wind mill. The converter can operate in two modes (a) Constant Voltage mode (b) Maximum Power Point Tracking mode. In CV mode the boost converter always tries to maintain the constant DC grid voltage. In MPPT mode the boost converter tries to extract the maximum power from the PV panel. A battery is used to maintain the constant DC grid voltage due to mismatch between supply and demand. When the demand is more than supply, the output voltage drops from its reference value, consequently battery will discharge to provide the surplus demand. Similarly, when the demand is less than supply, the output voltage increases from its reference value, consequently battery will charge to absorb the surplus power.

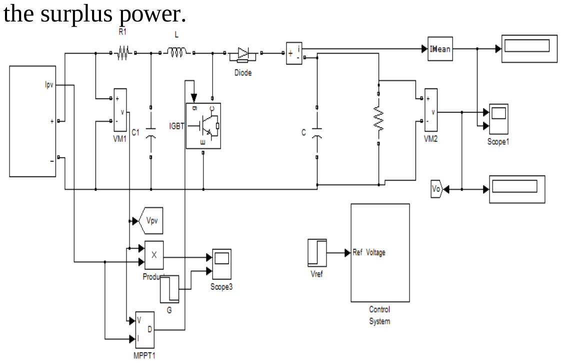

Figure 5 Simulation of PV

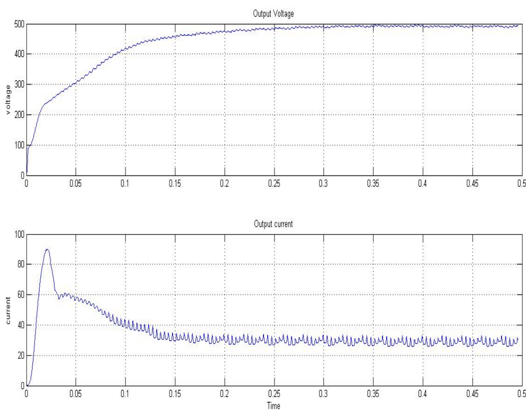

Figure 6 Output Voltage and Current of PV

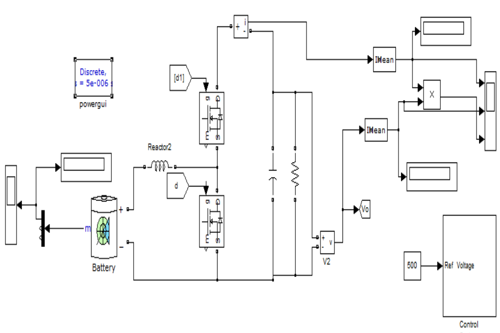

Figure 7 Simulation of Bi-Directional Converter

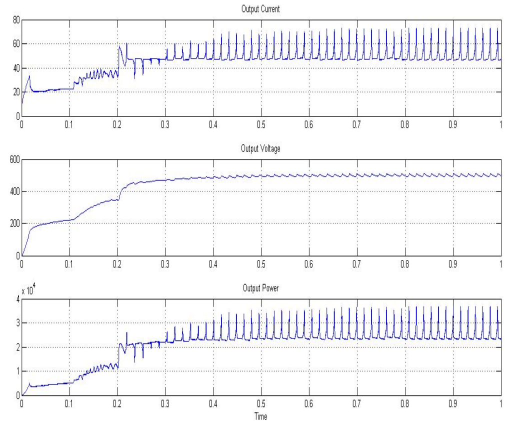

Figure 8 Output current, voltage and power of Bi-Directional Converter

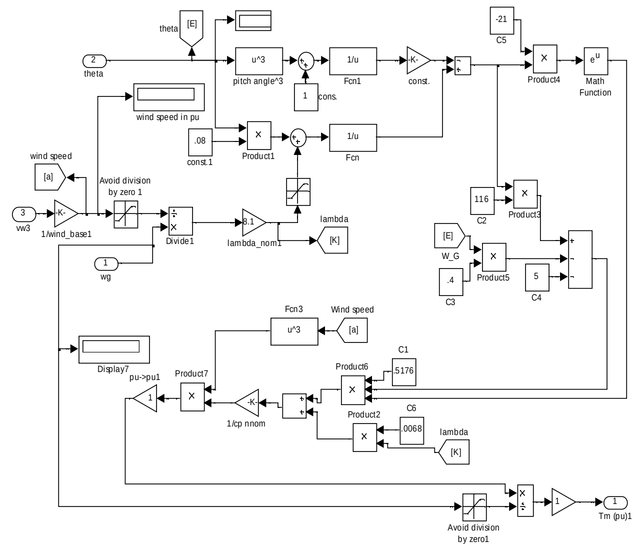

Figure 9 Simulation of Wind

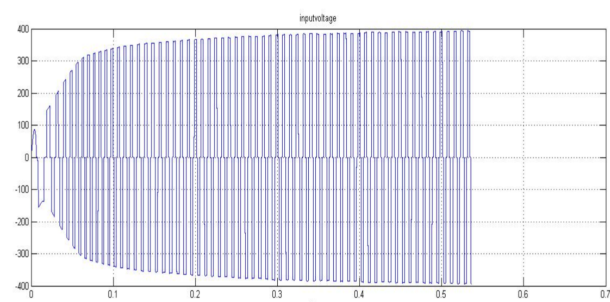

Figure 10 Input of Wind Mill

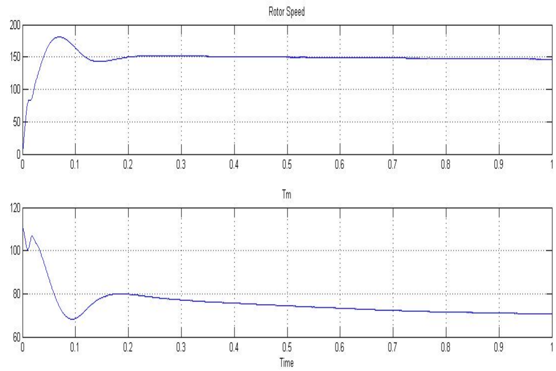

Figure 11 curve of rotor speed vs. time and mechanical torque vs. time

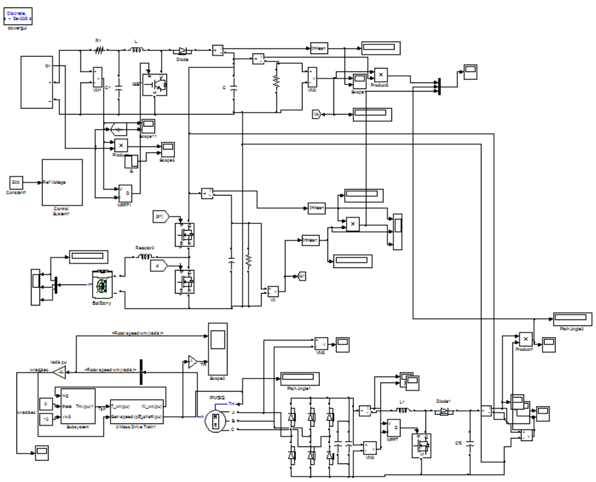

Figure 12 Simulation of Hybrid System

This is interconnecting system of PV cell, bidirectional converter and boost converter, wind mill and battery. Bidirectional converter use to maintain the dc grid voltage. Bidirectional converter work in two modes such as one is boost mode and another is buck mode. It converter work boost mode that time grid voltage is lower than the reference voltage. It converter work buck mode that time grid voltage is higher than the reference voltage. PV cell and wind mill are energy generate device. Output of the PMSG is the ac that convert the dc use to rectifier. A wind turbine is a machine that converts the wind power to electrical power; therefore the maximum energy delivered not only depends on the machine limits but also on wind speed. Let's clarify the difference between a wind turbine and a windmill. As it was mentioned before, wind turbines convert the power in the wind into electric power. On the other hand, windmills convert the power of the wind into mechanical power. drive train is used to rotation motion of turbine rotor is transmitted to the electrical generatorby means of a mechanical transmission.duty cycle varies to control the output of system.draive train use to incress and decrease the speed.

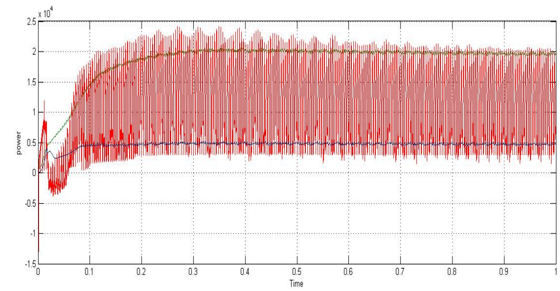

Figure 13 output power

Blue line is the output of bidirectional converter. Red line is output of wind mill and PV is the yellow line.

V. CONCLUSION

Simulations of solar cell, wind turbine, bidirectional converter and boost converter had completed in MATLAB environment. Solar power control with battery and hybrid system of solar, battery, wind, bidirectional converter design and analyze with different load condition. Results verified and analyzed as shown in this paper. All the problems and their solution s are explained.

REFERENCES

[1] Satish kumar kollimalla, maheshkumar mishra "Analysis and Control of DC-DC Boost Converter Using Average Power Balance Control" IEEE ICIAS 2012

[2] Narsa Reddy Tummuru , Mahesh. K. Mishra and S. Sriniva "Integration of PV/Battery Hybrid Energy Conversion System to the Grid with Power Quality Improvement" 978-1-4673-4569-9/13/2013 IEEE

[3] M. Mousavi Badejani, M.A.S. Masoum and M. Kalanta "Optimal Design and Modeling of Stand-Alone Hybrid PV-Wind Systems"

[4] Chia–tse lee, Hsin–Chen, ching-wei wang, ching hsiang yang, po-tai cheng "Average Power Control of DC Bus Voltages of Cascaded H-Bridge Multilevel Converters" 978-1-4799-2705-0/14/2014 IEEE